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Why Teach TECHNOLOGY?

By P. John Williams

Current developments in the field of technology are almost beyond belief. For example, in Japan, as a woman stands in front of a laser unit, it measures her clothing size and generates a computerized pattern. In ten minutes, she can walk away with a custom-made suit.

- In stable materials holes can be drilled that are only 20 angstroms across (one angstrom is 100 millionths of a centimeter). This process is being used in the manufacture of computer chips.
- Structures can be grown using metal reinforcing wire, sea water, and low voltage D.C. current. Such a structure is as hard as concrete, grows rapidly, and has virtually unlimited applications.
- Fiber optics now manufacture glass so pure that a window pane one mile thick would have no distortion.
- Steel can now be machined

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Every school must see as one of its primary functions the need to acquaint students with the nature of the technological culture.

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and shaped with a water jet.

• Using a glass strand only one-sixth as thick as a human hair, we can now transmit 6,048 simultaneous telephone calls. A laser that pulses 432 times a second can send the entire text of the *Encyclopaedia Britannica*—43 million words—over one fiber in five seconds.[1]

These amazing processes represent an increasingly important aspect of our society, which is currently undergoing dramatic changes. As early as 1969 it was stated that:

> Ours is possibly one of the most crucial periods in human existence. Poised in the transition between one kind of world and another, we are literally on the hinge of a great transformation of the whole human condition. The next 50 years may be the most crucial in all man's history. All of our previous local actions have now been magnified to a planetary level. The knowledge with which we might make the correct decision is barely adequate—yet our gross errors may be perpetuated for many generations.[2]

"Few informed persons now doubt that technically advanced societies like the United Stated are undergoing major transformation to some sort of 'post industrial' age."[3] Duvall, in discussing society and technology, stated unequivocally that "without question we are now standing at the crossroads."[4]

How Can We Prepare?

How should schools relate to the technological revolution described above? Most educators agree that preparation for life in society is one of the major goals of education. If that society is highly technological, then the educational curriculum should also have a strong technological component.

Some of the concepts currently taught in subjects such as math and science deal with the type of technological knowledge to which students need to be exposed. However, this is usually treated incidentally as it relates to the existing curriculum. There is seldom provision for a systematic application of technological principles in a practical and experimental manner. Industrial arts would seem to be ideal for this type of integration, since such activity is one of the goals of industrial arts, and the machinery, tools, and equipment already exist for practical technology education.

Industrial arts is ideally suited to help young people obtain the technological knowledge necessary to function in society.[5-9] Martin identifies technological literacy as one of the basic problems of society that should be addressed by industrial arts.[10] Every school must see as one of its primary functions the need to acquaint students with the nature of the technological culture.[11]

Curriculum Changes Are Needed

If there is a basic relationship between industrial arts and technology, and "technology is at the threshold of a new era,"[12] then industrial arts must itself be on the threshold of something new. Current literature reflects this, emphasizing that industrial arts must change in order to meet the current needs of society and to maintain relevancy in the curriculum.

Because the way people live has changed, many aspects of industrial arts no longer represent the "new society." Therefore, schools that continue to teach industry will in fact be teaching history, and their students will be learning from the past rather than preparing for the future.

The traditional practice of dividing the study of industry into material-centered courses such as wood, metal, and plastic no longer reflects the real world. Rarely does a technology involve only one material, and presenting such dichotomies misrepresents reality.[13]

The traditional preoccupation with project methodology as an end in itself no longer fulfills the goals of industrial arts. Teaching students how to make dovetail joints and incorporate them in the construction of birdhouses, for example, in no way prepares them for life in a highly technological society.

How can teachers integrate technology into industrial arts classes? Robert Vickery has called for a change in course content from traditional woods, metals, and drafting to courses such as manufacturing, construction, transportation, and communication.[13]

> Although the use of manipulative activities will be an important part of industrial arts programs in the future, these activities will be designed for learning about the broader conceptual areas of industry and technology.[14]

> Industrial arts as we know it is in serious trouble if we do not as a profession bring our programs into focus with the current state of the art in technology. We can no longer cling to a few selected activities which were based on a technology of half a century ago and pawn it off as relevant.[15]

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As society moves toward a technological orientation, SDA industrial arts education must consider what this means in terms of Christian philosophy and curriculum.

Illustrating Basic Principles

Education for the new technologies requires a shift in emphasis. Skills will still be taught and projects may still be constructed, but these will not be ends in themselves; they will be introduced into the curriculum only when needed to attain a particular goal. For example, if a course on the topic of transportation were being taught, students might construct a model car. In the traditional industrial arts context, the model would be the climax of the course. However, in a technology-related course in transportation, the model might be constructed of different materials, and then subjected to various stress and crash tests. It could be placed in a wind tunnel to determine drag coefficients and air-stream disturbance, and then have its design modified accordingly. So even though the course has taught manipulative skills and students have constructed a project (car), these accomplishments are not ends in themselves, but means to examine some of the basic technological principles used today. Therein lies the main difference between traditional industrial arts and technology education.

Even though today's technologies are very complex and often extremely intricate, they can be distilled into simple, basic principles. The teacher must illustrate and familiarize his or her pupils with the principles, rather than their vast and specific applications. A distinct advantage of technology education at the high school level is that expensive and sophisticated equipment are not required. Most industrial arts laboratories could move into the area of technology education without further expenditures on tools or equipment.

To illustrate the basic concepts of technology education, one example of an activity for each of the four areas of manufacturing, transportation, communication, and construction is presented below.

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Transportation Course

One unit of a transportation course could involve model rocketry. Such a class can capture the students' imaginations and inspire them while illustrating the basic principles of related technology. Manipulative skills are taught, and a project (rocket) is constructed in the process of familiarizing students with this technology. Such a project would not require any new or sophisticated tools or equipment.

To construct a rocket, students would be required to use materials commonly found around the laboratory. Model rocket kits are available, but students will learn more from constructing their own rockets. The rocket must hold the power source and a guidance system; it must be designed to withstand launch, travel through space, and landing. Plans could be given to the students for critical aspects of the rocket design,[16] while other

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about computers could go to almost any Christian college and gain adequate technical training for a career in this area.

Because of the high cost, however, specialties are offered only in restricted areas, primarily due to interest on the part of the constituency. Another example is auto mechanics. Not every North American Division college offers this training on the level needed to enter the job market; however, a number do.

An example of a more limited area of study is aviation. Several colleges and academies throughout North America offer aviation flight training (e.g., Andrews University, Pacific Union College, Walla Walla College, Blue Mountain Academy, Thunderbird Academy, and others). However, only one institution—Andrews University—offers an FAA-approved Airframe and Power Plant Mechanics School. Only a few people within our church system are interested in such intensive technical training; therefore, repetition of such a program would be impractical.

Promotion and Student Recruitment

The church must make a concerted effort to inform prospective students of the variety of technical programs available to them, and the many ways of financing such education. Every young person who desires technical training—and even those who haven't decided what career to pursue—should receive information about the wide variety of opportunities for such education in a Christian environment. □

FOOTNOTES

[1] Gerald W. Coy, "New Dimensions for the Changing University" (Unpublished paper), p. 8.

[2] The American Industrial Arts Association, "Technology Education: Direction for the Profession," *Technology Education, A Perspective on Implementation* (Reston, VA, 1985), p. 25.

[3] Walter B. Waetjen, "Opportunities and Problems for Industrial Arts," *Man/Society/Technology,* vol. 42 (May/June, 1983), p. 5.

[4] Ellen G. White, *Education* (Mountain View, CA: Pacific Press Publishing Assn., 1942), p. 218.

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elements could be left to their initiative, research, and experimentation. For example, the parachute storage and release mechanism could be devised by the student.

> *Schools that continue to teach industry will in fact be teaching history, and their students will be learning from the past rather than preparing for the future.*

In order to understand the theory related to this unit, the student would study solid fuel rocket engines, propellants, oxidizers, binders, and the reasons for different materials being used in the engine. Engines could be tested to chart their maximum thrust and effective burning time. Students can construct devices to measure altitude and time, after which the data can be used to make needed design modifications. Through the use of batteries and switches, students learn basic electronic principles as they construct the launching mechanism. The model rocketry project also helps students learn to use tools and material, offers them a leisure-time hobby, and provides insights into one of today's technologies.

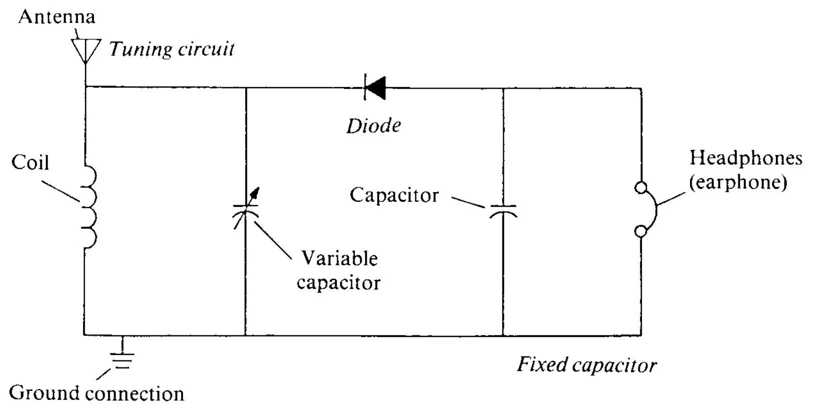
Communications

A unit in the communications course could revolve around the construction of a crystal radio, similar to the one illustrated in the figure below (materials can be found in local electronic supply stores). Students will begin to learn about communication by using electronic machines, while also developing skills such as sawing, filing, etching, soldering, and drilling. They will become acquainted with electronic symbols used in schematic circuit diagrams, and understand the meaning of *carrier waves, modulation, demodulation, frequencies,* and other terms relating to electronic communication.

Construction

A course in construction can teach students the major concepts associated with various types of

SCHEMATIC DIAGRAM OF A CRYSTAL RADIO



construction, such as commercial and residential buildings, bridges, and pipelines.

To introduce such a course the teacher could assign a research design problem such as the construction of a model bridge. After being supplied with materials (e.g., toothpicks, string, and glue) students are told to design a structure that will span a certain distance and support a specific weight. This will require research into various construction methods, a study of stresses and forces, oral presentation of the research to the class, and testing of the models.

A more extensive unit in such a course would apply group project methodology to some aspect of construction. First, divide the class into management and subcontract groups, each of which must research its role and then fit into the construction time schedule. Depending on the type of structure chosen, groups might include an architect and site supervisor, masons, framers, tilers, electricians, plumbers, carpenters, and cabinetmakers. Some of the systems could be prefabricated to a certain extent, and some students could fill more than one position. Presentations by subcontractors would expose the class to the broad range of construction technologies.

Technology education attempts to update industrial arts while retaining its basic activities.

Learning About Manufacturing

A course that demonstrates the activities and technologies of the manufacturing process is relatively easy to implement in the industrial arts framework. A corporation is formed and named, and officers elected or appointed to various positions such as the board of directors, personnel directors, treasurers, design engineers, production managers, and so on. A job description is given or researched for each position. The production process begins with a market survey to ascertain what type of product will sell. The designers then prepare a design from which engineers produce a model. From there the production managers break down the manufacturing process into successive tasks, each of which takes place at one station on the production line. The personnel directors then allocate and schedule students on production line stations. While this is going on, those students assigned the areas of advertising and finance design posters and advertisements, and raise money by selling shares in the corporation.

The actual production line may be in operation for only two or three days toward the end of the course, leaving time for the sale of the product and the distribution of dividends. A unit such as this exposes the students to a broad range of experiences associated with manufacturing processes, including proper use of authority, working cooperatively in groups, understanding different occupations, the role of money, as well as the manual skills required to produce a commodity.

Technology education, as can be seen from these few examples, attempts to update industrial arts while retaining its basic activities. In order to be more relevant, the courses avoid material-oriented divisions and emphasize technology principles, while still retaining the goal of manipulative skill development in the laboratory activities. The projects are student-centered, and do not require the sophisticated and expensive equipment one usually associates with current technology.

Education which relates to technology empowers people with the knowledge necessary to control the environment to meet human needs.

A Christian Overview

As society moves toward a technological orientation, SDA industrial arts education must consider what this means in terms of Christian philosophy and curriculum.

Many of the specific goals of SDA industrial arts education emanate from the philosophy that each person is created in the image of God, and that the role of education is to restore students to that image.[17]

The National Union of Christian Schools published a curriculum research paper in 1970 in which Gerald Laverman developed a philosophy of industrial arts that relates to technology. He asserted that education which relates to technology empowers people to control the environment to meet human needs. As a result, people can seek a fuller utilization of their God-given abilities.[18]

He further stated that the understanding of technology can be constructively viewed as a potential means of human expression and of concern for one's fellow men. This utilization of technology frees people for higher living and permits the development of previously unused talents.[19]

In addition, Laverman views technology not only as a revolution but also as a *revelation* by which men and women can more completely fulfill God's directions. God commanded Adam and Eve to subdue the earth and have dominion over it. Technological knowledge is the tool by which humankind can to a greater extent fulfill this objective.[20]

Stewardship Over Earth's Resources

Unfortunately, we have been somewhat overzealous in this regard. Having dominion over the earth in the Biblical context does not imply thoughtless or selfish abuse of Earth's resources as often happens in strip mining and chemical dumping. Subduing and dominating the planet must be balanced with God's broader ecological directives such as concern for all aspects of creation and the well-being of all people.

Teachers will have to do a good deal of thoughtful and innovative planning to integrate these principles into the curriculum, but it can be done. For example, in drawing classes, the student is often given the assignment of designing and drawing a residential dwelling. This project often results in the students competing to see who can design the biggest, most expensive, most exotic house. A more fitting assignment might be to design a dwelling for a particular developing country. To do so, students would have to research the style of living, specific requirements of the occupants and materials available in the area, while at the same time accommodating ecological principles. This would satisfy the goals of architectural drawing while sensitizing students to the needs, environments, and concerns of other people.

Traditionally, industrial arts has examined the iron and steel industry, with its use of traditional fuels such as oil and coal. However, students, as custodians of Earth's resources, could better spend their time concentrating on renewable energy sources such as wind, tides, and solar energy.[21] They could construct models that harness these types of energy on a small scale or in the context of a design problem. This would require testing, measurement of output, and resulting modifications.

If the goals of Christian education are to be reached in our schools, and graduates are to be adequately prepared for life in a technological society, then technology education cannot be an elective—it is an imperative that curriculum planners must address. Adventist educators need to give prayerful thought to their responsibility to promote a pervasive Christian philosophy that relates to all aspects of life in a technological society. □

FOOTNOTES

[1] M. James Benson, "The Soaring Technology Revolution," *The Technology Teacher*, 44:4 (January, 1985), p. 4.

[2] John McHale, *The Future of the Future* (New York: George Braziller, 1969), p. 15.

[3] Kendall N. Starkweather, "A Study of Potential Directions for Industrial Arts Toward the Year 2000," *Journal of Industrial Teacher Education*, 13:2 (Winter, 1976), p. 64.

[4] J. Barry Duvall, "The Year 2000 and Industrial Arts," *Man/Society/Technology* (May-June, 1980), p. 19.

[5] Donald Maley, "Perspectives on the Future: Industrial Arts Plays a Key Role in Future Education," *Man/Society/Technology*, 36 (January, 1980), pp. 10-15, 29, 30.

[6] John C. Walters, "Technology Education: Teaching Industrial Arts to Its Fullest Potential," *Man/Society/Technology*, 36 (May-June, 1977), pp. 233-235.

[7] Ronald M. Mangano, "Industrial Arts, Technology, and the Future," *Man/Society/Technology*, 42 (April, 1976), pp. 141, 147-149, 158.

[8] Starkweather.

[9] Delmar W. Olsen, "Interpreting a Technological Society: The Function of Industrial Arts," *School Shop*, 33:7 (March, 1974), pp. 35, 36.

[10] Gordon F. Martin, "Curriculum Implications for Technology Education—1990," *Man/Society/Technology*, 42 (April, 1983), p. 6.

[11] Olson, p. 36.

[12] Maley, p. 12.

[13] Robert D. Vickery, *Curriculum Guide for Power Technology* (Elwood, IN: Elwood Community High School, n.d.).

[14] Kendall N. Starkweather, "Industrial Arts in a Post-Industrial Age," *American Vocational Journal*, 51:8 (November, 1976), p. 82.

[15] M. J. Benson, "Summary—A Parting Perspective," in H. A. Anderson and M. J. Benson, eds., *Technology and Society: Interfaces With Industrial Arts, American Council on Industrial Arts Teacher Education 29th Yearbook* (Bloomington, IL: McKnight, 1979), p. 335.

[16] At least 11 books plus plans and other information are available on model rocketry from Estes Industries, Inc., Penrose, CO 81240.

[17] North American Division Office of Education, *Framework for Applied Arts* (Washington, DC: General Conference of SDA, 1979), p. iii.

[18] Gerald Laverman, *Industrial Arts in the Christian School* (Chicago: National Union of Christian Schools, 1970), p. 21.

[19] *Ibid.*, p. 17.

[20] *Ibid.*, pp. 20, 21.

[21] Glenn Mider, *Renewable Energy Systems*, Eastern Illinois University.

Technology and the Secondary Curriculum

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will students use in this learning activity? What safety hazards exist, and what procedure will I follow to educate the student concerning these hazards?

3. What method will I use to be sure the students understand safety procedures and habits? What steps should I take if one of the students has an accident?

In order for students to become technologically literate in our modern society teachers must use technological advances as steppingstones to help the pupils understand the subject at hand, including the way technology is changing our present and future society and the advantages that can result from these changes. □

FOOTNOTES

[1] Los Angeles Trade-Technical College, CA. *Master Plan for the Introduction of High Technology Instructional Programs*. Office of Instruction Report No. 82-1 (Bethesda, MD: ERIC Document Reproduction Service, ED 248912, 1982), p. 8.

[2] *Ibid.*

[3] Wisconsin State Department of Public Instruction, Madison. *Industry and Technology Education. A Guide for Curriculum Designers, Implementors, and Teachers. Bulletin No. 4432* (Bethesda, MD: ERIC Document Reproduction Service, ED 248340, 1984), p. 9.

[4] Stephen Solomon, "Designing Artificial Joints by Computer," *Technology Review*, 87:7 (October, 1984), pp. 76, 77.

[5] Richard H. Hersh, "On Roads, Bridges, and Schools: The Infrastructure Necessary for Technology Literacy," *American Association for Higher Education Bulletin*, 35:7 (March, 1983), p. 4.

[6] Timothy B. Jay, "The Future of Educational Technology," *Educational Technology*, 22:6 (June, 1982), p. 22.

[7] Illinois State Board of Education. *Communication Technology Curriculum Guide 1984* (Springfield, IL: Department of Adult, Vocational, and Technical Education).